Remarks:

Applicants, by their attorney, confirm the election of the invention of Group I, and reserve their patent rights to these inventions, including their right to file divisional patent applications on these inventions. However, as to Claim 5, Applicants note that this withdrawn claim was originally drawn to depend from Claim 1, and have repeated the subject matter thereof in new Claim 6.

The Examiner has rejected Applicants' original Claims 1 and 2 under 35 US 112 second paragraph, alleging that the claims are indefinite. In particular, the examiner states that it is not clear how the contingent tax is to be calculated, and has pointed out the lack of antecedent basis for a number of terms used in those claims. Applicants have set forth the best mode for calculating this parameter, for example in Formula 7, and has stated in Paragraph 45, line 13 " The contingent tax is the difference between the market value of the asset and its tax basis multiplied by the expected effective tax rate upon liquidation (the contingent tax rate)." Since "tax basis" is a well known term defined by tax laws, IRS regulations, an common usage of the term, Applicants have not chosen to otherwise define this term. Amended Claim 1 now includes a detailed recitation of the characteristics of the investments to correct any antecedency concerns.

The Examiner has also alleged that Claims 1 and 2 fail to recite any elements of the claimed product. Claim 1 as now amended set forth steps in a novel and unobvious method for optimizing a portfolio of investments. Thus Claim 1 and its dependent claims 2 and 6 do not need to

recite the characteristics of a product in order to particularly point out and distinctly claim what Applicants regard as their invention.

In numbered paragraph 3, the Examiner in effect alleges Applicants' original Claims 1 and 2 to be obvious over the teachings of the Frank patent ("'399") in view of the Reichenstein article ("Reichenstein").

While it may be true that '399 describes the concept of accounts, these accounts are specifically limited to one of two types: taxable and tax-deferred. Also, '399 does not deal in any way with determining the optimal investment allocation between asset classes. Rather, '399 describes a method of determining investment allocation, given that the allocation as between "investments" (and hence, asset classes) is already specified. With such investment allocation already determined, he suggests means by which one might allocate such holdings between the two specified types of accounts. The '399 Abstract states: "Once an investor or investment advisor determines the appropriate asset allocation, the invention will optimize/maximize the investor's ending after-tax asset accumulation,...This is accomplished by allocating the chosen investment vehicles between the taxable and tax-deferred accounts..."

In contrast, Applicants' inventive method does not limit the user to accounts of only two types of tax specifications. Further, Applicants' claimed method operates on both the allocation between accounts and between asset classes.

Contrary to the Examiner's assertions, '399 does not mention contingent taxes. Figure 7 in '399 shows inputs for the simulation procedure used to produce results indicated for Figure 8 (as specified in lines 34-36 of Appendix A) of portfolio holdings (prior to application of the "optimization" procedure disclosed) in "taxable" accounts. Prior to application of '399's "optimization" there is no consideration of contingent taxes, as the amounts listed in column 10 of Figure 7 are merely current pre-tax holdings. (Refer to user input in Figure 6.) Also, similar comments hold for amounts in column 11 of Figure 1 which are current holdings in "tax deferred" accounts.

The Examiner has pointed to the recitation of "constraints" in Column 8, lines 40 and 42 of '399. However, these constraints merely specify the minimums and maximums of investments allowed in either taxable or the tax deferred accounts. The '399 patent does not teach the possibility of general linear constraints on combinations of asset classes. At best '399 suggests fixed allocations of assets, thus predetermining a single constraint, but nowhere suggest how to convert this single constraint to after tax equivalents prior to the disclosed optimization steps. In contrast, Applicants' invention defines asset allocations as outcomes of the claimed method, not as preexisting constraints.

In discussing the Reichenstein reference, the Examiner states in effect that Reichenstein discloses c. determining pre-tax constraints on what investments are to be contained in the portfolio as to asset classes, and d. transforming the pre-tax constraints and pre-tax investment characteristics into a set of after-tax constraints and pre-tax investment characteristics into a set of after-tax constraints and investment characteristics, including after-tax expected returns and volatility esti-

mates. and e. adjusting market values of financial assets in each portfolio to reflect the effect of the contingent tax on the assets.

It is true that Reichenstein recognizes the importance of looking at a given asset allocation on an after-tax basis. However, it proposes no method of optimization, and most importantly, it does not discuss or mention use of constraints—either before-tax or after-tax—and the necessity of converting before-tax constraints to after-tax constraints in any optimization procedure. Exhibit 1 in the article does, however, implicitly illustrate that after-tax allocations are net of contingent taxes. Furthermore, Reichentein does not discuss how to calculate after-tax total returns from pre-tax total returns.

Attached hereto is a subsequent article by Reichenstein, "After-Tax Asset Allocation", Financial Analysts Journal, Volume 62, Number 4, July/August 2006—(the "2006 article") published well after Applicants' priority filing date. The 2006 article suggests means of estimating ending wealth models for bonds and stocks in various savings vehicles using specific formulas. The formulas are all presented in a form with pre-tax returns. Such formulas could be manipulated to specify after-tax returns, but they would be valid only for simple, special cases. The 2006 article also discusses in passing the concept of after-tax expected returns. Only Applicants teach how to derive after-tax expected returns from pretax expected returns of asset classes and their tax attributes in the general case.

Nowhere in the Reichenstein article is there any discussion of the calculation of standard deviation of rates of return. Granted the article does state that the risk of a pension assets contingent liability "is precisely equal to the risk of the pension asset." The statement is obviously false, however, except in the limited case where the contingent liability equals the pre-tax value of the pension asset (i.e. the after-tax value of the asset net of its contingent tax), is precisely zero.

In contrast, the 2006 article does discuss the calculation of risk of "various savings vehicles" in Table 3. From the context of various other parts of the 2006 article one can reasonably conclude that risk in the context of that presentation is the standard deviation of the return of the specified savings vehicle. Implicit in this Table 3 is the suggested formula that the after-tax standard deviation of the savings vehicle is merely a specified constant tax rate times the pre-tax standard deviation. But this implicit teaching from the 2006 article is not available as prior art. Further, on page 18 column 1, the 2006 article incorrectly states that "cost bases of assets held in taxable accounts may be relaxed" that is, ignored. Notably, the 2006 article does recognize that "optimal asset allocation" and "optimal asset location" (that is, to which account each asset class is to be held—the subject of Frank's patent) "must be made jointly".

In sum, Reichenstein does little more than show illustrations of why taxes matter and present a case to the effect that the composition of any portfolio should be reviewed on an after-tax basis, and illustrates the need for Applicants inventions. Accordingly, Applicants' Claim 1 is patentable over the combination of '399 and Reichenstein.

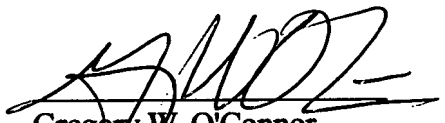
Regarding Claim 2, the examiner states that '399 discloses calculating after-tax returns and pre-tax return using corresponding pre-tax return [col.5 line 46; col. 4 lines 20-28; claim 2]. The '399 patent does discuss the general practice of determining pre-tax returns by asset allocation, and claim 2 in '399 describes the calculation of an after-tax accumulation for the entire portfolio from randomly selected amounts from the two types of taxable and tax-deferred accounts. It does not, contemplate, calculate, or utilize individual asset class expected after-tax rates of return.

The Examiner further states that calculating standard deviations is known, and that it would be obvious for a person having ordinary skill in the art to modify the disclosures of the '399 patent and Reichenstein and include calculating pre-tax and after tax standard deviations to evaluate haw close the data spreads are and as a result of this calculation make best allocation decision.

Applicants hold an opposite view in that this step, even if the applied references could be combined without benefit of Applicants' disclosure, would not be obvious. Calculating the after-tax standard deviation of total return is neither simple nor straightforward. The process taught in the '399 patent does not consider the standard deviation of returns as an input. Reichenstein's article does not discuss calculation of the standard deviation of expected rates of return, although the 2006 article does, which would indicate that one of ordinary skill would not find Applicants' invention obvious at the time of invention.

Claims 1, 2 and 6 are now in condition for allowance. If there any remaining issues, the Examiner is invited to call Applicants' attorney to resolve them.

Respectfully submitted,



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PERSPECTIVES

After-Tax Asset Allocation

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In the asset management world, agreement is widespread that an investor's most important decision is asset allocation. Based on this consensus, you might think that there is wide agreement about how an individual's asset allocation should be calculated. If you thought this, you would be wrong!

Several studies have concluded that we have been mismanaging individual investors' asset allocations in two ways. First, the asset allocation should distinguish between pretax funds in a tax-deferred account, such as a 401(k), and generally after-tax funds in other savings vehicles. For example, the traditional approach to calculating asset allocation inappropriately implies that $1 of *pretax* funds in a 401(k) is the same size as $1 of *after-tax* funds in a taxable account. Yet, if withdrawn in retirement today by someone in the 33 percent tax bracket, the $1 in the 401(k) would buy $0.67 of goods and services whereas the $1 in the taxable account would buy $1 of goods and services. According to these studies, an individual's asset allocation should be based on assets' after-tax values.[1]

Second, when considering whether someone is prepared for retirement, financial advisers routinely consider income from all resources—Social Security, defined-benefit plans, and the individual's financial portfolio. When considering someone's asset allocations, however, advisers may look only at the financial portfolio. Several studies have concluded that financial advisers should manage an individual's extended portfolio, which goes beyond the traditional financial portfolio to include the values of all sources of retirement income.[2]

Not surprisingly, Nobel Laureate Harry M. Markowitz was one of the first to recognize the implications of the "clear differences in the central features of investing for institutions and investing for individuals" (1991, p. 1). To note one key difference, institutional funds are usually tax deferred or tax exempt but individual funds are often taxable. Markowitz stated that the family is clearly concerned with after-tax returns. He discussed the impact of taxes on the calculation of an individual's asset allocation and related issues. Concerning the concept of an individual's extended portfolio, Markowitz proposed studying individual portfolio management as a "game of life" that includes "such things as IRAs, Keogh plans, social security payments, [and] pension plans" (p. 4). The game-of-life model requires the financial adviser to manage the individual's extended portfolio.

A lot of research has been conducted since Markowitz's paper on the differences between managing institutional and individual portfolios. In this article, I concentrate on the importance of distinguishing between pretax funds and after-tax funds when calculating asset allocation. I explain why assets' after-tax values should be used in calculating an individual's asset allocation. In addition, I present models that indicate how the choice of savings vehicles affects the percentage of principal effectively owned by, returns received by, and risk borne by the individual investor. Finally, I refer to some of the investment implications of this after-tax asset allocation framework.

Logic of After-Tax Asset Allocation

This section builds on previous research concluding that the traditional approach to calculating an individual's asset allocation is wrong because it fails to distinguish between pretax and after-tax funds. An individual's asset allocation should be based on each asset's after-tax value. In addition, I explain here how pretax funds should be converted to after-tax funds.

Table 1 presents the savings vehicles of Dan and Danielle, a married couple in their mid-50s. They are in the 33 percent ordinary income tax bracket before retirement and expect to remain in this bracket during retirement. Dan invests $1,000 today in a 401(k) or any other tax-deferred account (TDA). The contribution reduces his taxable income by $1,000, which reduces taxes by $330. So, this contribution reduces this year's spending by $670. We can think of the $1,000 contribution as consisting of $330 of tax savings plus $670 of Dan's after-tax funds. Danielle invests $670 today in a Roth IRA. Both Danielle's $670 contribution to the

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Table 1. Pretax Funds in 401(k) vs. After-Tax Funds in Roth IRA

Savings Vehicle	Original Investment	Ending Wealth
Dan—401(k)		
Pretax	$1,000	$2,000
Tax savings	330	660
After tax	$670	$1,340
Danielle—Roth IRA		
After tax	$670	$1,340

Roth and Dan's $1,000 contribution to the 401(k) represent contributions of $670 of after-tax funds, and they both reduce this year's spending by $670.

Each invests in the same mutual fund for the same length of time. It could be a money market fund, a bond fund, or a stock fund. For simplicity, assume it's a stock fund and the monies are withdrawn during retirement after the account values have doubled. The Roth IRA is worth $1,340 after taxes (assuming the Roth was established at least 5 years earlier and Danielle is at least 59 1/2 years old). The 401(k) is worth $2,000 pretax, which translates to $1,340 after taxes. So, both Dan and Danielle invested $670 of after-tax funds and they are both worth $1,340 after taxes at withdrawal.

Suppose the 401(k) and Roth are Dan and Danielle's only two financial assets. Their market values are $2,000 and $1,340 at retirement, and Danielle transfers her Roth IRA to a bond fund. What is their allocation?

According to the traditional approach to calculating their asset allocation, the $2,000 in the 401(k) is 49 percent larger than the $1,340 in the Roth IRA. So, they have a 60 percent stock/40 percent bond asset allocation.

According to the after-tax approach, we should first convert the accounts' market values to after-tax values and then calculate the asset allocation on the basis of these after-tax values. The after-tax approach converts the $2,000 of pretax funds in the 401(k) to $1,340 of after-tax funds. This approach says their asset allocation is 50 percent stocks (Dan's $1,340 after taxes) and 50 percent bonds (Danielle's $1,340 after taxes).

If the traditional approach is wrong, then the profession has been miscalculating individual investors' asset allocations and thus mismanaging their portfolios. Furthermore, the traditional approach's miscalculation—overstating the stock allocation by 10 percent in this example—can be substantial.

This example illustrates three points. First, when calculating asset allocation, the $2,000 of pretax funds in Dan's 401(k) is the same size as the $1,340 of after-tax funds in Danielle's Roth IRA because they both buy the same amount of goods and services. The asset allocation calculation should be based on assets' after-tax values because goods and services are purchased with after-tax funds. Stated differently, the asset allocation calculation should be based on assets' after-tax values because this approach equates after-tax dollars to after-tax dollars. In contrast, the traditional approach equates $1 of *pretax* funds in TDAs to $1 of *after-tax* funds.

Second, when the tax rate in the contribution year equals the tax rate in the withdrawal year, the after-tax value of funds in TDAs grows effectively tax exempt.

Third, we can convert pretax funds in TDAs to after-tax funds by multiplying by $(1 - t_r)$, where t_r is the expected tax rate during retirement. Dan's $1,000 original deposit and the $2,000 at withdrawal should be viewed as worth $670 and $1,340 after taxes. Some individuals may say they do not know what their marginal tax rate will be during retirement. However, because the traditional approach views the $2,000 in the 401(k) as being worth 49 percent more than the $1,340 in the Roth IRA, it implicitly assumes that the expected tax rate during retirement will be zero. Although an individual's tax rate during retirement may be uncertain, an adviser can easily improve upon an implicit assumption of zero.

A second example will illustrate that, even if the tax rates in the contribution year and withdrawal year are not the same, the proper way to convert pretax values in TDAs to after-tax values is to multiply by $(1 - t_r)$. Jake and Janet are similar to Dan and Danielle in that they are in their mid-50s and in the 33 percent tax bracket before retirement, but they expect to be in the 28 percent bracket during retirement. Jake contributes $1,000 to a 401(k) and expects to withdraw the funds during retirement. What is the after-tax value of this investment immediately after the contribution? Although the $1,000 contribution reduces this year's spending only by $670, after the contribution, they should view its after-tax value as $720 or $1,000$(1 - t_r)$. Because Jake expects to withdraw the funds during retirement, the pretax value of his TDA should be converted to after-tax funds by multiplying by $(1 - t_r)$. The after-tax value grows from $1,000$(1 - t_r)$ today to $1,000$(1 + r)^n(1 - t_r)$ in n years, where r is the asset's pretax rate of return. *The after-tax value of tax-deferred accounts grows effectively tax exempt.*

Adjusting Taxable Accounts for Embedded Gains and Losses. Sometimes, an asset in a taxable account has embedded but unrealized capital gains or losses. In this case, the appropriate approach may be to reduce the asset's market value for the embedded tax liability or increase the

market value for the tax savings from the embedded tax loss. Unfortunately, as Markowitz noted, "it is not always clear . . . how to treat unrealized capital gains" (1991, p. 9).

Suppose a stock has a market value of $10,000 and a cost basis of $6,000 and the individual is in the 15 percent capital gains tax bracket and 33 percent ordinary income tax bracket. If the stock is sold today as a short-term gain, taxes are $1,320 on the $4,000 gain and the after-tax value is $8,680. If the stock is sold today as a long-term gain, the after-tax value is $9,400. In Reichenstein and Jennings (2003), we argued that the $9,400 after-tax valuation is probably reasonable for individuals who plan to sell the stock within a few years. In two scenarios, however, there will be no taxes on the unrealized gain. If the individual (1) awaits the step-up in basis at death or (2) uses the appreciated asset to finance a charitable donation, the gain is tax free. In these scenarios, the stock's after-tax value will be the same as the market value. In short, there is not one way that is always the "right" way to handle the tax consequences of the unrealized gain. A financial adviser can add value to clients' accounts, however, by helping them understand the tax consequences of their stock management strategies.

Calculating the After-Tax Asset Allocation. To calculate the after-tax asset allocation, we must first convert all asset values to after-tax values and then calculate the asset allocation based on these after-tax values. From my experience, the major adjustment for most individuals is the conversion of pretax funds in their TDAs to after-tax values. In other words, for most individuals, there is relatively little difference between pretax values and after-tax values of assets held in taxable accounts.

Sharing of Principal, Returns, and Risk

Models can indicate how the choice of savings vehicles (e.g., Roth IRA, TDA, or taxable account) affects the individual investor's ownership of principal, returns, and risks. **Table 2** presents after-tax ending wealth models per $1 currently in a Roth IRA, a TDA, and a taxable account. For assets held in a taxable account, the assumption is that the assets' cost bases equal their market values. The underlying asset can be a bond or stock. The pretax rate of return is r. For simplicity, assume the stock returns are all in the form of capital gains. (The major conclusions do not change, however, as long as any portion of stock returns is taxed at a rate lower than the ordinary income tax rate.) Each model presents the after-tax ending wealth after n years per $1 currently in the savings vehicle. The ordinary income tax rate is t for all years before withdrawal and t_r in the withdrawal year. The long-term capital gains tax rate is t_c, and t_c is lower than the ordinary income tax rates (i.e., $t_c < t$ and $t_c < t_r$).

Table 2. After-Tax Ending Wealth Models for Bonds and Stocks in Various Savings Vehicles

Savings Vehicle	Bonds	Stocks
Roth IRA	$(1 + r)^n$	$(1 + r)^n$
TDA	$(1 + r)^n(1 - t_r)$	$(1 + r)^n(1 - t_r)$
Taxable account		
Bonds	$[1 + r(1 - t)]^n$	
Day trader		$[1 + r(1 - t)]^n$
Active investor		$[1 + r(1 - t_c)]^n$
Passive investor		$(1 + r)^n(1 - t_c) + t_c$
Exempt investor		$(1 + r)^n$

Note: Assumptions are that the individual is at least 59 1/2 years old before withdrawing funds from the Roth and TDA and that the Roth has been in existence for at least 5 years.

For bonds and stocks held in a Roth IRA, the after-tax ending wealth model is $(1 + r)^n$. The account begins with $1 of after-tax funds and is worth $(1 + r)^n$ after taxes n years hence.

For bonds and stocks held in a TDA, the account begins with $1 of pretax funds. It is worth $(1 + r)^n$ pretax and $(1 + r)^n(1 - t_r)$ after taxes n years hence.

For assets held in taxable accounts, bonds have one model but stocks have a separate model for each management style. For bonds, the model states that $1 of after-tax funds earns r percent pretax annually and grows at the $r(1 - t)$ after-tax rate of return.

Among the stock management styles, the day trader realizes all gains within a year and pays taxes on all returns at the ordinary income tax rate. The active investor realizes all gains as soon as they are eligible for the capital gains tax rate (i.e., at one year and one day) and pays taxes at the long-term capital gains rate, t_c. The investor either actively manages individual stocks or invests in an active stock fund that is managed in this style. According to the model, $1 of after-tax funds earns r pretax annually and grows at the $r(1 - t_c)$ after-tax rate of return.

The passive investor buys and holds stocks for n years and realizes the gain at the end of n years. This investor either passively manages individual stocks or buys and holds passively managed stock funds. The model is $(1 + r)^n(1 - t_c) + t_c$ or, equivalently, $(1 + r)^n - t_c[(1 + r)^n - 1]$. The second version may be easier to explain. The $1 of after-tax money grows tax deferred at the rate of r for n years. Its pretax value immediately before withdrawal is $(1 + r)^n$. Upon withdrawal, the deferred returns—that is, $[(1 + r)^n - 1]$—are taxed at t_c, the capital gains tax rate; the original $1 was already after taxes and can be withdrawn tax free.

As the name implies, exempt investors never pay taxes on capital gains. They either donate the appreciated stock to a qualified charity or await the step-up in basis at death. If they donate the stock, they can deduct the market value, $(1 + r)^n$, and the charity, because of its tax-exempt status, can avoid taxes. If investors await the step-up in basis, then at their death, their beneficiaries' cost basis is stepped up to $(1 + r)^n$, the market value at death. No one pays taxes on the n years of unrealized capital gains.

These stock models illustrate specific advantages of being a progressively more passive investor. Compared with the day trader, the active investor benefits from the preferential capital gains tax rate. Compared with the active investor, the passive investor defers taxes until the end of the investment horizon. Compared with the passive investor, the exempt investor never pays taxes.

Table 3 indicates the percentages of principal effectively owned by, return received by, and risk borne by individual investors in each savings vehicle. As shown, in contrast to bonds and stocks held in a Roth IRA, for bonds and stocks held in a TDA, the investor effectively owns $(1 - t_r)$ of the principal but receives 100 percent of returns and bears 100 percent of risks.

The example of Jake and Janet illustrated this insight. Jake had $1,000 of pretax funds in a TDA and expected to withdraw the funds in retirement, at which time, he would be in the 28 percent tax bracket. When calculating his asset allocation, the adviser should consider today's $1,000 of pretax funds to be $720 of after-tax funds. Jake's after-tax value grows from $1,000(1 – 0.28) today to $1,000(1 – 0.28)$(1 + r)^n$ in retirement; the after-tax value grows at the pretax rate of return; thus, it grows effectively tax exempt. When bonds are held in taxable accounts (with cost bases equal to market values), the investor owns 100 percent of the principal but receives about $(1 - t)$ of the pretax return and bears about $(1 - t)$ of the pretax risk. The government takes the remaining return and bears the remaining risk.

Table 3. Principal Owned, Return Received, and Risk Borne by Individual Investors in Various Savings Vehicles

Savings Vehicle	Principal	Return	Risk
Roth IRA (bonds and stocks)	100%	100%	100%
TDA (bonds and stocks)	$(1 - t_r)$	100	100
Taxable account			
Bonds	100	$(1 - t)$	$(1 - t)$
Stocks, day trader	100	$(1 - t)$	$(1 - t)$
Stocks, active investor	100	$(1 - t_c)$	$(1 - t_c)$
Stocks, passive investor	100	$> (1 - t_c)$	$> (1 - t_c)$
Stocks, exempt investor	100	100	100

To illustrate the risk and return sharing of bonds held in taxable accounts, we assume bonds have a 4 percent expected return and 8 percent standard deviation and that the investor is in the 25 percent tax bracket. Suppose bonds earn pretax returns of –4 percent, 4 percent, and 12 percent in three years; that is, they earn the mean return and 1 standard deviation below and above the mean. The standard deviation of these returns is 8 percent. Assuming the 4 percent loss is used to offset that year's taxable income, the investor's after-tax returns are –3 percent, 3 percent, and 9 percent, for a standard deviation of 6 percent. In this case, the investor receives $(1 - t)$ of pretax returns and bears $(1 - t)$ of pretax risk. If the loss is used to offset long-term capital gains that would have been taxed at 15 percent, then the 4 percent pretax loss produces a 3.4 percent after-tax loss; in this case, the investor receives approximately $(1 - t)$ of returns and bears approximately $(1 - t)$ of risk. Although only approximate, Table 3 assumes the individual receives $(1 - t)$ of the bond returns and bears $(1 - t)$ of their risk.

When stocks are held in taxable accounts (with cost bases equal to market values), the investor owns 100 percent of the principal but the portion of returns the investor receives and the risk borne depend on the stock management style. For the passive investor, for example, the portion is about $(1 - t_c)$ when the investment horizon is one year, but the effective tax rate decreases as the horizon lengthens. For instance, if the underlying asset earns 8 percent a year for 20 years, then for a $1 original investment, the after-tax ending wealth is

$$(1.08)^{20}(1 - 0.15) + 0.15 = \$4.11.$$

This amount is a 7.33 percent after-tax rate of return:

$$4.11^{(1/20)} - 1 = 0.0733, \text{or } 7.33\%,$$

which is an effective annual tax rate of

$$\frac{0.08 - 0.0733}{0.08} = 0.084, \text{or } 8.4\%.$$

To illustrate risk and return sharing, we assume stocks have an 8 percent expected return and 12 percent standard deviation. Stocks earn pretax returns of –4 percent, 8 percent, and 20 percent in three years—that is, the mean return and 1 standard deviation below and above the mean. The standard deviation of –4 percent, 8 percent, and 20 percent is 12 percent. If the 4 percent loss is used that year to offset long-term capital gains, the active investor's after-tax returns are –3.4 percent, 6.8 percent, and 17 percent for a standard deviation of 10.2 percent. In this case, the investor receives $(1 - t_c)$ of pretax returns and bears $(1 - t_c)$ of pretax risk. If the 4 percent loss is used to offset that year's taxable income or a later year's capital gain, the active

investor receives about $(1 - t_c)$ of returns and bears about $(1 - t_c)$ of risk, as assumed in Table 3.

Table 3 provides several lessons:

- First, the adviser should think of the individual investor with a TDA as owning $(1 - t_r)$ of its principal.
- Second, the choice of savings vehicle affects the portion of return received by and risk borne by the individual investor. Individuals effectively receive all returns and bear all risks on assets held in a TDA or Roth IRA, but they generally receive only a portion of returns and bear only a portion of risks on assets held in taxable accounts.
- Third, the same underlying asset can be effectively a different asset when held in a different savings vehicle. For example, consider a bond with a pretax expected return of 4 percent and pretax risk of 8 percent. For an individual in a 25 percent tax bracket, the bond's after-tax return and after-tax risk are 4 percent and 8 percent when the bond is held in a TDA or Roth IRA, whereas pretax return and risk are about 3 percent and 6 percent when held in a taxable account. Therefore, in a mean–variance optimization, a bond held in a Roth IRA or TDA is effectively a different asset from the same bond held in a taxable account.

The assumption that the cost bases of assets held in taxable accounts equal their market values can be relaxed. When a capital gain is built in, the individual may effectively own less than 100 percent of the principal. But the choice of savings vehicle still affects the portion of returns received by and risk borne by the individual investor.

Asset Location in an After-Tax Framework

This framework has implications for the determination of an individual's optimal asset location as well as optimal asset allocation. *Asset location* refers to the decision to locate bonds in retirement accounts and stocks in taxable accounts, or vice versa, while the target asset allocation is retained. Until recently, scholars recommended that these decisions be made sequentially: First, determine the optimal asset allocation, and then, determine the optimal asset location (see Shoven and Sialm 1998; Shoven 1999). Today, we recognize that these decisions must be made jointly

One of the conclusions we can draw from the after-tax framework is that, except for the extreme case of a day trader, individuals should locate bonds in retirement accounts and stocks, especially passively managed stocks, in taxable accounts. The benefit of this asset location increases with the spread between the ordinary income tax rate and the effective tax rate paid on stocks held in taxable accounts. So, the asset location decision should be most important to high-income individuals who passively manage stocks held in taxable accounts. Reichenstein (2001a) and Dammon, Spatt, and Zhang (2004) examined the implications of stock management style for individuals; Brunel (2001, 2004) expanded asset location issues to include assets held in trusts and other savings vehicles.

Conclusion

Taxes matter! Financial advisers who use the traditional approach to calculate individuals' asset allocations are miscalculating their true allocations. This approach fails to distinguish pretax funds from after-tax funds. Furthermore, the measurement errors can be substantial. Obviously, proper management of individuals' portfolios requires proper measurement of their asset allocations. This study advocates the calculation of an individual's after-tax asset allocation. This approach compares after-tax funds with after-tax funds, so it corrects the major deficiency in the traditional approach.

Taxes also matter for the choice of savings vehicles. The difference in taxation of assets held in Roth IRAs, TDAs, and taxable accounts affects the portions of principal effectively owned by, returns received by, and risk borne by individual investors. In a Roth IRA, the individual investor effectively owns all principal, receives all returns, and bears all risk. In a TDA, the individual effectively owns $(1 - t_r)$ of principal, receives all returns, and bears all risk. In taxable accounts (with cost bases equal to market values), the individual effectively owns all principal but generally receives only a portion of returns and bears a portion of risk.

Therefore, the after-tax approach has implications for asset location. In general, bonds and other assets whose returns are taxed at ordinary income tax rates should be held in retirement accounts, whereas stocks, especially passively managed stocks, should be held in taxable accounts.

This article qualifies for 0.5 PD credit.

Notes

1. Reichenstein (1998, 2000, 2001b); Reichenstein and Jennings (2003); Jennings and Reichenstein (2004); Dammon, Spatt, and Zhang (2004).
2. For more discussion of this second issue, see Reichenstein (1998, 2000, 2001b), Reichenstein and Jennings (2003), and Jennings and Reichenstein (2004).

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